Rhodora

JOURNAL OF THE

NEW ENGLAND BOTANICAL CLUB

Conducted and published for the Club, by

MERRITT LYNDON FERNALD, Editor-in-Chief

JAMES FRANKLIN COLLINS
CHARLES ALFRED WEATHERBY
LUDLOW GRISCOM
CARROLL WILLIAM DODGE
} Associate Editors

VOLUME 31

1929

The New England Botanical Club, Inc.
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JOURNAL OF

THE NEW ENGLAND BOTANICAL CLUB

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EDITORIAL ANNOUNCEMENT

After thirty years of devoted and gratuitous service the original editorial board of Rhodora has asked to be relieved of the responsibility of carrying on the journal; and a new board, containing only one of the original editors, has been appointed by the Council of the New England Botanical Club. With this change in the management of the journal it is appropriate to summarize very briefly the accomplishments of thirty years.

The cover of Volume 1, no. 1, issued January 2, 1899, enumerated the board: Benjamin Lincoln Robinson, Editor-in-Chief; Frank Shipley Collins, Merritt Lyndon Fernald and Hollis Webster, Associate Editors; William Penn Rich and Edward Lothrop Rand, Publication Committee. The cover of Volume 30, no. 360 (December, 1928) contains four of these names, the original board having lost by death Collins in 1920 and Rand in 1924. Collins's place on the board was filled in June, 1920 by the selection of Lincoln Ware Riddle, whose promising career was cut short in January, 1921; and in 1923 Carroll William Dodge took the place on the board left vacant after Riddle's death. The position of Rand was not filled. Thus, in its first thirty years Rhodora has been conducted by essentially the same board of editors; and, although to those who have followed the journal from the start the devotion of the original board has been repeatedly apparent, the new board of editors cannot take up its duties without realizing the difficulties it will encounter in emulating the constant attention to technique and proper presentation which have characterized the time-consuming and too often thankless editorial work of Dr. Robinson and the tedious and uncomplaining labor behind the scenes of Mr. Rich in personally sending out to subscribers all the copies of 360 numbers of the journal.

Those who knew the earlier days of RHODORA will also remember the great debt of the board to Collins, Webster and Rand, faithful attendants at all editorial meetings, judicious critics and advisers in editorial details and ready contributors to the pages of the journal.

The first thirty volumes contain 6698 pages of botanical matter, averaging 256 pages per volume; the smallest, of 207 pages, Vol. 22, immediately followed by the largest, Vol. 23 with 318 pages. The following statistics covering these volumes clearly show certain trends.

Volume	Pages	Articles	Contributors (old and new)	New Contributors each year	Plates[1]	New Botanical Names
1 (1899)	246	116	59	(59)	11	30
2 (1900)	260	114	60	17	11	33
3 (1901)	315	103	59	31	13	57
4 (1902)	268	126	68	29	6	32
5 (1903)	308	88	40	17	10	71
6 (1904)	254	89	51	12	11	35
7 (1905)	286	71	38	14	5	84
8 (1906)	246	74	33	8	8	138
9 (1907)	252	62	41	13	4	59
10 (1908)	234	74	49	14	2	210
11 (1909)	254	77	39	9	5	33
12 (1910)	245	65	31	5	2	41
13 (1911)	269	85	44	12	10	32
14 (1912)	254	84	46	11	6	31
15 (1913)	240	82	46	9	6	59
16 (1914)	225	74	35	8	6	67
17 (1915)	252	66	36	9	3	87
18 (1916)	269	61	35	9	8	146
19 (1917)	288	71	36	11	4	106
20 (1918)	220	64	29	7	3	86
21 (1919)	234	65	30	7	2	113
22 (1920)	207	57	28	8	2	51
23 (1921)	318	46	33	8	7	101
24 (1922)	259	45	31	4	5	73
25 (1923)	236	57	29	8	2	73
26 (1924)	249	61	36	8	9	62
27 (1925)	224	52	23	8	5	104
28 (1926)	260	46	30	8	3	63
29 (1927)	268	53	36	10	3	21
30 (1928)	258	60	39	17	19	90
Total	6698	2188	1190	399	191	2188
Range	207–318	45–126	23–68	4–31	2–19	21–210
Average	256	73	40	12	6	73

From this summary it is at once apparent that during its first four years RHODORA published, on the average, 115 articles by 61 or 62 contributors in each volume; but that after the fourth year the number

[1] Including unnumbered portraits.

both of articles and of contributors quickly fell to an average for the next twelve years of 77 articles by 41 contributors per volume, and again in the remaining fourteen years to an average of 57 articles by 32 contributors. This decrease is, of course, due largely to two factors: first, the early publication of a great number of brief notes from amateur collectors and observers who, at the end of four years, had seriously depleted their list of noteworthy items; second, the gradual increase of longer monographic papers and extended studies now often continued through two or more numbers. Thus, in the fourth volume (with the maximum number of articles as well as of contributors) there were ninety-five notes or brief articles, from a single paragraph to two pages in length, and only two articles of ten or more pages; but twenty years later, Volume 24 (with the minimum number of articles) had only eighteen papers under two pages in length but nine long articles, of ten to thirty pages each.

It will be noticed that practically 400 (399) different botanists have contributed articles to RHODORA. In addition 45 of these authors have also contributed plates; but besides these authors whose names have appeared on the title-page, thirteen artists, draughtsmen and photographers have furnished plates, mostly without charge and often in large number. Such authors of plates, added to those who have supplied the text, give us 412 individuals who have furnished the scientific matter in the first thirty volumes. These generous contributors of plates, whose names have not appeared either on title-pages or in indices, are: Blanche Ames, R. C. Collins, Anna Q. Churchill, C. E. Faxon, G. B. Fessenden, W. R. Fisher, Edna L. Hyatt, A. M. Johnson, E. H. Lincoln, F. S. Mathews, L. H. Merrill, R. E. Torrey, Una F. Weatherby.

From the editorial viewpoint there is special satisfaction in having a group of collaborators who can be relied upon to submit articles at frequent intervals, and it is gratifying to note that the retiring board was able so to rely upon a substantial group of authors. Outside the editorial board, whose pens or erasers were evident in all volumes, 20 botanists contributed to at least one-third (10) of the volumes, 1 of them (Evans) to 20, 1 (Deane) to 22, and 1 (Knowlton) to 27. Such loyalty deserves special acknowledgment and these most faithful supporters of RHODORA should at least be here enumerated: H. H. Bartlett, C. H. Bissell, S. F. Blake, Ezra Brainerd, E. B. Chamberlain, J. F. Collins, Walter Deane, E. H. Eames, A. W.

Evans, Emily F. Fletcher, Nellie F. Flynn, E. B. Harger, C. H. Knowlton, Bayard Long, F. Schuyler Mathews, A. S. Pease, C. S. Sargent, C. A. Weatherby, K. M. Wiegand, R. W. Woodward. Only limit of space prevents the enumeration of others who contributed extensively to a smaller number of volumes.

Fifty-six years ago, William H. Leggett, the founder of the pioneer *Bulletin of the Torrey Botanical Club*, in directing attention to the then young fields of plant anatomy and plant physiology, said: "Many causes have led botanists in America to give their attention more particularly to the systematic part of the science; but this field has been so well worked, and is so full of workers, that there is little room for any new comer to add much to our knowledge in this department." Leggett was giving voice to an impression which soon became a common one in America, especially among those whose enthusiasm was fired by the lure of microscopic technique and laboratory experiments but who soon forgot the need of knowing the exact identities and the phylogenetic, ecological and geographic relations of the plants with which they dealt. It is now clear, however, that there have been abundant opportunities for all new comers and that the fields of systematic and geographic botany, even in the areas naturally centering about New York and Boston, are far from exhausted. This statement has been vividly demonstrated by the publication in the thirty volumes of RHODORA of nearly 2200 novelties, chiefly from northeastern America; and by the notable fact that, although the pages of RHODORA have been freely open to every field of botany, all but a dozen at most of the 400 authors submitting papers for publication have been students of the systematic and geographic fields or of the natural history of plants. The real demand for a journal such as RHODORA is further attested by two striking facts: first, that, although the full issues of 600 copies were printed and additional issues of 500 reprints each were sent out, the demand in Europe as well as America for several papers of broad systematic, phytogeographic or geological interest has been such that the surpluses are exhausted and it may prove desirable again to issue reprints; second, that, far from being a journal of local New England interest and influence, RHODORA is regularly consulted in the libraries and herbaria of 33 Old World botanists, botanical institutions or universities, and in Dr. Eric Hultén's great work on the flora of Kamtchatka (certainly as remote from New England as any region

of the northern hemisphere), now being issued from Stockholm, references to papers published in RHODORA are surprisingly numerous. The period of general indifference to systematic and geographic botany is, then, rapidly passing and these subjects are again being recognized as fundamental to intelligent pursuit of the other branches of botany; and it has been repeatedly demonstrated of late that these old and neglected fields are full of unexplored paths and have many contacts with other fields long supposed to be separated from them by impassible barriers. Consequently, instead of being "well worked" with little opportunity "to add much to our knowledge," they are proving to be almost unexplored and peculiarly fruitful sources of discoveries and of far-reaching deductions.

With this optimistic belief the new board takes up RHODORA well pleased to note that, whereas in 1922 only 4 new botanists joined the ranks of contributors, the number of new authors increased in 1923 to 8, in 1927 to 10 and in 1928 to 17. If this rate of increase can be maintained we may look forward to a general use of the pages of the journal comparable with the happy state from 1899 to 1902. The New England Botanical Club, which sponsors RHODORA, itself contains approximately 225 members, selected because of their intelligent interest in our flora and the problems connected with it. Nevertheless, 104 members have never seen their names on the title-page of RHODORA. Whether the journal can continue to increase its contributing constituency depends very largely upon the Club itself.

The pages of RHODORA are not reserved, however, for members of the Club. They are freely open to all who care to use them, especially for the publication of tersely stated notes on range-extensions or new or unrecorded facts regarding habits, morphology, habitats or other features of interest to students of all plants (both vascular and cellular) or the natural history of plants. Systematic revisions and monographs of groups represented in the flora of northeastern America will be welcomed for editorial consideration and well-written and descriptive (but not prolix) accounts of explorations, containing a good share of new or significant observations, will be gladly considered. Mere lists without clear statement of the significance of the records are less desirable. Illustrations of new species and of newly recognized diagnostic characters are most desirable and in so far as limited resources allow they will be favorably consid-

ered for publication. Photographs of landscapes, unless they are remarkably sharp and of patent significance to the discussion, are undesirable for reproduction and, in general, RHODORA cannot commit itself to publish them. In such matters as nomenclature, punctuation, capitalization of specific names, modes of bibliographical citation, and other matters of form, contributors have full power to follow personal preferences, provided their usage is consistent with itself. Manuscripts which show serious lack of consistency will necessarily be returned for correction. In case of misquotations, erroneous citations and other inaccurate details in manuscripts the editors will naturally make corrections of obvious errors. They cannot, however, be expected specially to check such matters and it will be inferred that authors have themselves verified such essential details. Neither can the editorial board be held responsible, as some readers have heretofore supposed them to be, for all statements and conclusions presented by different authors. In the case of controversial subjects, with the desire to present both sides of a question, papers may be accepted for publication, though not representing the views of the editors.

When, thirty years ago, the board was seeking a suggestive and brief name for the new journal, Edward Rand, realizing that a technical scientific journal must frequently ask for financial aid from its sponsors, suggested *Taxus;* but it became evident that such a title, staring the subscribers in the face each month, would ultimately prove detrimental to the subscription list. One reason for originally selecting the name RHODORA, was the range of the shrub bearing that colloquial name: Labrador and Newfoundland to western Quebec, south to Pennsylvania. Any well-prepared and new material on the flora of this area is obviously appropriate for RHODORA; but the geographic limits covered by the journal are elastic and, space permitting, material from outside this area will be gladly considered.

THE APPLICATION OF THE TERM "RHIZOME."

THEO. HOLM.

(Plates 177 and 178.)

IT is a common fact that the subterranean organs of reproduction are either passed by in silence or incompletely described in Botanical

Manuals. The floral structure is, of course, the most important in such works, but characters derived from the vegetative organs of reproduction are also of importance to classification, and indeed very useful in large genera, where uniformity in floral structure is prevailing. The application of the proper terms to the various subterranean structures has also been a difficult matter, and the term rhizome, for instance, has caused great trouble to the systematists. And no wonder, because the morphologists have not, so far, come to any agreement as to its proper definition. Therefore we often see the term applied to almost any type of subterranean stems, rhizomes proper, stolons, tubers and the like; thus the diagnosis may give a wrong idea of the particular habit of some species. When, in the following pages, the writer presents some brief notes dealing with the term rhizome, it is with the intention to suggest how some improvement might be made, and with special reference to Gray's Manual.

The term has quite a history, and according to Link[1] Ehrhart[2] was the first author to employ the term for the rhizome of ferns; Link himself (l. c.) defined it as: "basis caulis intra terram demersa," and he mentions that some authors, for instance, Bernhardi and Willdenow use the term for the thicker portion of the root. Link distinguished between rhizome and tuberous stolons. Mirbel[3] did not use the term rhizome, but it occurs in the index of the terms as a synonym for "racine progressive," and some of the examples given are: *Gratiola officinalis*, *Polygonum bistorta*, *Convallaria polygonatum*, *Plantago major*, etc., with the important statement: "Les racines progressives sont, à proprement parler, des tiges enracinées." Seringe and Guillard[4] applied the term only to: "tiges souterraines et horizontales." By Lindley[5] rhizoma was defined as: "a prostrate thickened rooting stem, which yearly produces young branches or plants," chiefly found in *Irideae* and epiphytous *Orchideae*. According to De Candolle[6] a rhizome should be subterranean "caché sous terre"; *Arum*, *Nymphaea*, *Iris* and European ferns are cited as examples. Nevertheless, as early as the year 1833 the term must have been misused

[1] Link, H. F. Elementa philosophiae botanicae. Berlin, 1824, p. 129.
[2] Ehrhart, Fr. Beiträge zur Naturkunde IV, p. 44, 1787.
[3] Mirbel, Brisseau-C. F. Elémens de Physiologie végétale et Botanique. Pars 1, p. 91, Pars 2, p. 620. Paris, 1815.
[4] Seringe, N. C. et Guillard: Essai de formules botaniques. Paris, 1836, p. 116.
[5] Lindley, John. An introduction to Botany. London, 1832, p. 58.
[6] De Candolle, Alph. Introduction a l'étude de la Botanique. Vol. 1. Paris, 1835, p. 44.

to a great extent, for Bischoff[1] recommended to give it up altogether, having become an uncertain synonym for entirely different plant-organs. In North American manuals "rhizome" was introduced by Torrey in his flora of the State of New York (1843), and with but a few exceptions Torrey applied the term in the proper manner; these exceptions depended upon the fact that Torrey could not draw the distinction between rhizomes and stolons, notably in the case of the *Gramineae* and *Cyperaceae*. With regard to the *Orchidaceae* Torrey applied the term to *Goodyera*, but the rhizome of *Corallorrhiza* he called a root; the term "pseudo-bulb" adopted from Lindley was used for *Microstylis*, *Liparis*, *Arethusa*, etc., which shows that Torrey really observed that these plants have no bulbs in the stricter sense of the word, although described as possessing such by many systematists. With regard to *Dicentra Cucullaria* Torrey gives an excellent description viz: "Rhizome not creeping, bulbiferous, the bulbs formed of fleshy imbricated triangular scales (the thickened and persistent bases of petioles)."

It is interesting to compare this work of Torrey with that of Doell, published in the same year (1843)[2] because this author did not either draw any distinction between rhizomes and stolons in the case of the *Gramineae* and *Cyperaceae;* Doell, however, described the rhizome of *Corallorrhiza* in the correct manner. Very characteristic of Doell's Flora (l. c.), besides his Flora of Baden,[3] is the morphological treatment of the inflorescences and floral structures, notably in the *Gramineae* and *Cyperaceae*, which is far superior to that by Torrey and subsequent authors of American manuals. Morphological studies were altogether given much attention in Germany at that time; we need only to cite such fundamental works as those of Irmisch,[4] and Alexander Braun,[5] followed soon by numerous others. However, so far as concerns the definition of the subterranean stem-structures the first edition of Gray's Manual[6] corresponded fairly well with that given by his contemporaries. As

[1] Bischoff, G. W. Handbuch der botanischen Terminologie. Vol. 1, p. 124. Nürnberg, 1833.

[2] Doell, J. Ch. Rheinische Flora. Frankfurt a. M., 1843.

[3] Doell, J. Ch. Flora des Grossherzogthums Baden. Carlsruhe, 1857–1862.

[4] Irmisch, Thilo. Zur Morphologie der monokotylischen Knollen-und Zwiebelgewächse. Berlin, 1850.

[5] Braun, Alexander. Betrachtungen ueber die Erscheinung der Verjüngung in der Natur. Leipzig, 1851.

[6] Gray, Asa. Manual of the Botany of the Northern United States. Boston and Cambridge, 1848.

shown in the dedication of this volume to Torrey, Gray acknowledged the importance of the help he had received from this author from the commencement of his botanical pursuits. Considered in a general manner Gray adopted the terminology used by Torrey, but he used the term root-stock instead of rhizome. The definition given by Gray (l. c., p. XIV) of "rootstock or rhizoma" reads: "Usually horizontal, sending off roots from the under side or the whole surface, and advancing from year to year (being always perennial) by the growth of the bud at its apex" is not quite complete, but certainly more significant than the definition given in Gray's New Manual (1908) viz: "Any prostrate or subterranean stem, usually rooting at the node and becoming erect at the apex." Although Gray defined "tuber" as a portion of a subterranean stem, which is thickened by the deposition of nutritive matters, differing from a rhizome in being borne on a slender stalk, he described *Dicentra Cucullaria* as having a cluster of grain-like tubers, although Torrey had described this very correctly; moreover Gray called the tuberous roots of *Claytonia, Erigenia, Nabalus* and some others "tubers." Considering the early publication (1848) errors of that kind are excusable, and there are relatively only a few of them. And, when we compare the work of Grenier and Godron,[1] published in the same year as Gray's Manual, we must certainly admit that both Torrey and Gray had used the term rhizome or rootstock much more correctly. While the term "souche" according to Littré,[2] means: "le bas du tronc d'un arbre accompagné de ses racines et séparé du reste de l'arbre," this term is frequently used by French authors for herbs. For instance Grenier and Godron use "souche" for the subterranean stems producing stolons: *Epilobium, Sium, Geum*, etc., as well as for the tuber of *Arum*, and the rhizome of *Iris*, while *Acorus, Calla, Nymphaea*, etc., are described as possessing rhizomes; on the other hand, the rhizomes of *Goodyera* and *Corallorrhiza* are called "racine." In Germany the term rhizome became well defined by several authors, notably by Schacht,[3] and the examples he cites are characteristic: *Iris, Acorus, Convallaria, Corallorrhiza, Goodyera*, etc. At that time, we might say since 1843, morphological botany made wonderful progress, founded by Mirbel

[1] Grenier et Godron. Flore de France, Paris, 1848.
[2] Littré, E. Dictionnaire de la langue Française. Paris, 1876.
[3] Schacht, H. Lehrbuch der Anatomie und Physiologie der Gewächse. Pars 2. Berlin 1859. p 21.

in France, and actually continued by the Germans, and with great success. As an example of the beneficial effect, these morphological studies had on systematic botany we may cite Ascherson's Flora,[1] a work containing excellent diagnoses of the species, and with the subterranean organs correctly defined; in this work *Cirsium arvense* and *Rumex Acetosella* are described as multiplying by means of root-shoots, and not by "running rootstocks." While subsequent authors in Europe availed themselves of the profuse material brought together in the literature, the various editions of Gray's Manual were not brought "up to date," at least not with reference to the morphology of the vegetative organs. Even in the last edition (1908) there is frequently no clear distinction drawn between the various types of subterranean stems, rhizomes, tubers, stolons, etc. This is especially noticeable in the treatment of the *Orchidaceae*, where the tubers of *Pogonia trianthophora* are described as "tuberoids" = roots, where bulbs are attributed to *Calopogon*, *Arethusa*, *Microstylis* etc., although not a single member of this family possesses a bulb, but true tubers or rhizomes. In the *Gramineae* "running rootstocks" is the only characterization of the subterranean stem, although most of these are simply stolons. Furthermore "creeping rootstocks" are attributed to *Cirsium arvense* and *Rumex Acetosella*, by Irmisch correctly described as "root-shoots," and recorded as such by Ascherson (l. c.); the tuberiferous stolons of *Krigia* are called roots, while the roots of *Claytonia*, *Nabalus* and *Erigenia* are called tubers. In other words the errors committed in the first edition have not been corrected, and several others have been inserted.

Meanwhile it must be admitted that systematic works even of a more recent date do not always give the exact definition of the subterranean structures. And, moreover, it is not seldom to be seen that some of the terms, notably "rhizome," are applied to organs, which are not rhizomes, by authors of morphological works. No serious attention was given to the matter until Warming[2] made the suggestion, that the term "Rhizome" should be restricted to horizontal subterranean stems with short, generally thick internodes, rich in nutritive matters, and frequently with only a few roots (*Anemone nemorosa*, *Polygonatum*, *Scrophularia nodosa*, *Dentaria bulbifera*). Warming, furthermore, expressed the belief that rhizomes

[1] Ascherson, Paul. Flora der Provinz Brandenburg. Berlin, 1864.

[2] Warming, Eug. Om Jordudloebere. Kgl. Danske Vid. Selsk-Skrifter. Series 8, II, 6. Kjoebenhavn, 1918, p. 299.

most frequently represent the primary axis, developed directly from the plumule. The material studied by this author was principally of Scandinavian origin, a fact that may explain the somewhat narrow definition of the term. This suggestion that rhizomes might be restricted to the primary axis, appears to the writer as exceedingly important; we only wish to alter the expression "might be restricted" to "must in the future be restricted."—This would facilitate the proper application of the term, but would, of course, involve studies of the seedling stages in order to see the further growth of the plumule. But even if so, studies in that line would be of great value to the knowledge of the biology of the plants, especially of the North American, known but so very imperfectly from this particular point of view. With regard to the European plants, they are known so well, that the definition of the subterranean stem as a rhizome would cause no difficulty of consequence. Moreover, the various subterranean stems of the North American species may be fairly well understood by comparison with the results given in the copious literature published abroad on this subject, even if based upon material mostly European.

Before describing some examples of rhizomes of North American species, the writer wishes to refer to the literature presented some few years ago,[1] where the seedling-stage has been described, beside the further growth of the plumule.

We might state at once, that rhizomes may be horizontal or vertical, homogeneous or heterogeneous, monopodial or sympodial, root-bearing or rootless, the latter being only represented by *Corallorrhiza* and *Hexalectris*. Although the tuber of *Arisaema*, and the bulbs of various *Liliaceae* are developed directly from the plumule, we do not include these under rhizomes, since they are so very distinctive, and should therefore be defined simply as respectively tuber and bulb; the term "corm" as exemplified by *Crocus*, *Colchicum*, *Gladiolus* and certain species of *Iris*, does not appear to be represented by any of the plants described in Gray's Manual, and will therefore be omitted. On the other hand, the distinction between rhizome, stolon and runner, difficult as it be, will be briefly touched upon in the subsequent pages.

[1] Holm, Theo. Hibernation and rejuvenation exemplified by North American herbs. The American Midland Naturalist. Vol. IX, 1925.

I. Horizontal, Homogeneous Rhizomes.

Tripsacum dactyloides L. The seedling (fig. 2) shows the thin, primary root (R), and several relatively thick secondary roots, developed from the internodes of the primary axis. This axis is almost erect, and consists of four internodes, terminated by a vegetative growing point with a few green leaves, and with a lateral bud. In the succeeding year (fig. 3) axillary buds have developed, each with an adorsed fore-leaf or prophyllon (P), which is sharply two-keeled as shown in the cross-section (fig. 4). The growing point is still purely vegetative, and remains so until the development of the first culm; after that time a lateral bud takes its place, thus the ramification of the shoot becomes changed from a mono- to a sympodium. By the continued growth the primary axis becomes appressed to the ground, and lateral branches soon develop; thus the mature rhizome represents a tangled mass of thick, very short internodes, and bears many green leaves. The root-system is well represented, especially on the lower face of the rhizome. With the exception of the membranaceous fore-leaves all the other leaves are green, the rhizome being close to the surface of the soil, and often freely exposed to the light, at least the upper face of the axes. Similar homogenous rhizomes with all the internodes of the same thickness, and with green leaves occur also in *Acorus*, *Iris versicolor* L., *Goodyera*, *Nymphaea* and several species of *Viola: V. papilionacea* Pursh and its allies. More frequent, however, are rhizomes, which bear scale-like leaves preceding the aerial, green ones, as in *Uniola gracilis* Michx., *Panicum virgatum* L., *Eleocharis tenuis* (Willd.) Schult. and several other species, *Dulichium*, *Scirpus Americanus* Pers., etc., *Fuirena scirpoidea* Michx., several species of *Carex* (*Vignea*), of *Juncus*, for instance *J. scirpoides* Lam., *Smilacina*, *Polygonatum* (fig. 1), *Smilax herbacea* L., *S. tamnifolia* Michx., *Chamaelirium*, *Oakesia*, *Dioscorea* and several others. Among the *Dicotyledones* this type of rhizome is represented by *Podophyllum* (fig. 8), *Sanguinaria*, *Dentaria diphylla* Michx., and *Asarum*, but is relatively rare.

Among the rhizomes of the latter category, with scale-like leaves, are several of which the internodes are not exactly of the same thickness as, for instance, in *Polygonatum*, *Smilacina* and *Podophyllum*, where the internodes bearing the floral stems are distinctly thicker than the others, but of the same cylindric form; thus the rhizome may well be called homogeneous. Characteristic of the rhizome of *Viola*

is, that the bases of petioles and stipules persist and increase in thickness, becoming quite fleshy. In *Dentaria diphylla* the scale-leaves are quite thick and fleshy, while in the other examples mentioned these leaves are membranaceous and very thin.

There are thus some distinct forms observable in this type of rhizome: the horizontal, homogeneous, but common to all of these, except the *Viola papilionacca* alliance, is the monopodial structure until the production of the first floral stem, when the sympodium begins. As regards *Viola* the rhizome remains a monopodium throughout the life of the individual, being terminated by a rosette of leaves subtending the flowers; among the caulescent Violets this same structure recurs, for instance in *V. scabriuscula* Schwein. and *V. striata* Ait.

II. Vertical, Homogeneous Rhizomes.

This type is rare. It occurs in *Gentiana villosa* L. (fig. 7), and is relatively stout, with several thick, fusiform roots, very short internodes, and bearing only thin scale leaves. The ramification is monopodial throughout the life of the plant, and green leaves do not appear until upon the flower-bearing stem. In *Viola pedata* L. the rhizome is also relatively stout and monopodial, but all the leaves are green, forming a dense rosette with several to many axillary flowers. A corresponding, but very robust rhizome is possessed by *Symplocarpus foetidus* (L.) Nutt. In *Panax quinquefolium* L. and *P. trifolium* L. the very short rhizome is of several, short internodes bearing scale leaves, exactly alternate, and with the primary root persisting: large, fusiform in the former, small, globose in the latter species; the shoot is a monopodium until the first floral stem becomes developed. A similar, very short rhizome is exemplified by *Hepatica triloba* Chaix var. *americana* DC.; the terminal bud, purely vegetative, is surrounded by several membranaceous scale-leaves, besides that the green leaves from the preceding year's growth form a rosette around the bud. The very short rhizome, of only two to three internodes, in *Viola primulifolia* L. and *Uvularia perfoliata* L. persists only for two or three years, when axillary stolons develop and produce new individuals showing exactly the same structure as the mother plant, the primary axis. Finally in the genus *Carex* it is a marked characteristic of the grex *Lejochlaenae*, besides several species of *Dactylostachyae* that the primary axis persists for several years as a true monopodium with all the flower-bearing stems being axillary.

While thus the primary axis passes from a mono- to a sympodium after the first flowering in *Panax*, it remains a monopodium in all the other genera described, throughout the life of the shoot.

III. Horizontal, Heterogeneous Rhizomes.

An alternation of single, or series of several slender internodes with tuberous internodes makes the structure of the rhizome heterogeneous. It is a type almost confined to the *Monocotyledones*, and especially well represented in the *Orchidaceae*. The simplest structure is shown by *Dentaria laciniata* Muehl. (figs. 10–11), where the plumule at once develops into a small tuber, bearing a green leaf, and a scale-like, covering the minute, apical bud. The fully matured rhizome (fig. 11) consists of a horizontal chain of oblong tubers, separated from each other by one to two very thin internodes, each tuber representing the growth of one season. Similar to *Dentaria diphylla* Michx., the structure is monopodial until the production of the first flowering stem. It is a structure agreeing with that of *Cyclamen*, *Umbilicus*, *Eranthis* and certain species of *Corydalis* so far as concerns the development of the plumule into a tuber, but in these genera the primary tuber does not branch any further, but persists as a single tuber throughout the life of the individual. *Cardamine Douglassii* (Torr.) Britt. (fig. 6) has also a tuberous rhizome interspersed with slender internodes, but so irregularly, that the structure, mono- or sympodial, can not be determined. *Hydrophyllum Canadense* L. shows the peculiar structure of a series of relatively large, very thick and fleshy scale-leaves preceding two green leaves, which again surround another series of scale-leaves with the floral stem in the center. Very regular, and much more distinct is the rhizome of *Medeola virginiana* L. (fig. 5), where the large tuber of three internodes passes, sympodially, into a long, very slender internode terminating in another tuber.

In *Fuirena squarrosa* Michx. we observe the development of erect tubers intermixed with slender, flower-bearing shoots on a horizontal rhizome.[1] The growing apex of the tubers is arrested in its further development. This structure seems to be a very rare case in the *Cyperaceae*, for in this family tubers are either developed at the apex of stolons as in *Cyperus phymatodes* Muehl., *Scirpus robustus* Pursh and several other species, or they form a regular chain as in

[1] Holm, Theo. Fuirena squarrosa Michx. and F. scirpoidea Vahl. Am. Journ. of Sc. IV, 1897, p. 13.

Cyperus filiculmis Vahl., *Scleria pauciflora* Muehl., and several other species.

With regard to the *Orchidaceae* heterogeneous rhizomes represent a multitude of types, and several are well exemplified by North American genera. The study of these structures has been facilitated to a very great extent by the classic investigations of Irmisch, Pfitzer and Reichenbach, but they must be studied in nature, not in herbaria. So long as we know that neither bulbs nor corms exist in this family as shown by Pfitzer,[1] the matter has become very much simplified, and a brief characterization of the genera contained in Gray's Manual may be sufficient. In *Corallorrhiza odontorhiza* Nutt. the coral-like rhizome is heterogeneous, because the branch developing into an aerial, floral shoot, forms a small tuber from which the floral stem emerges. In *Corallorrhiza trifida* Chatelain, on the other hand, the non-development of this tuber makes the rhizome homogeneous as in *Hexalectris*. In *Aplectrum*, *Tipularia* and *Calypso* there is an alternation, and very regular, of tubers and slender internodes; of these the tubers are terminated by a vegetative bud, which remains dormant, thus each tuber is a monopodium, while the total rhizome represents a sympodium; furthermore in *Aplectrum* and *Calypso* a secondary rhizome is also developed in the manner exactly like that of *Corollorrhiza*, coral-like and much branched, which may be found occasionally beneath the tuber, especially in young specimens.

The tuber of *Calopogon* resembles that of *Aplectrum* and the two other genera, but the apex grows out as a small shoot with one scale-leaf, and one green leaf, surrounding the base of the terminal inflorescence; in *Aplectrum*, *Tipularia* and *Calypso* the inflorescence is axillary. In *Arethusa* the tuber consists of two internodes, of which the apical represents the base of the floral scape. A corresponding participation of the floral stem in forming the tuber recurs in *Liparis* and *Microstylis*. It might appear by a superficial glance as if "rhizome" ought not to be attributed to *Arethusa*, *Liparis* and *Microstylis*, since no slender internodes are actually visible; the tubers of these genera, however, are not single, but represent a part of a horizontal rhizome, of which the older portions are very frequently preserved, even if in a withered condition.

[1] Pfitzer, Ernst. Grundzüge einer vergleichenden Morphologie der Orchideen. Heidelberg, 1882.
Pfitzer, Ernst. Orchidaceae in Engler und Prantl. Die nat. Pflanzenfam Leipzig, 1888.

Finally we might mention the so-called "pseudo-rhizome" a term proposed by Nilsson.[1] It simply applies to a complex of persisting stem-bases, with their buds and system of roots. It is exemplified by *Phryma leptostachya* L. (fig. 12), and a number of other plants, *Collinsonia*, many *Leguminosae*, etc. But in this subterranean stem, the primary axis is not the sole one to develop into a persisting organ, but the cotyledonary shoots take also a part in its formation, and the final structure is very variable, but generally more or less tuberous. The persisting basal internodes generally show a well marked increase in thickness, and a more or less pronounced lignification of the stelar tissues.

These various structures described above, may be sufficient for defining the subterranean stems as representing a rhizome. The difficulty depends on distinguishing them from stolons, at least in the *Gramineae* and some of the *Cyperaceae*, when their origin as axillary stems can not be proved; for stolons are always axillary and subterranean; runners are also axillary, but aerial (*Fragaria*, *Antennaria*, *Erigeron*, *Cynodon*, etc.). In several genera of the *Labiatae* for instance, the stolons are terminated by tubers, and thus readily to be determined, but in the *Gramineae* and *Cyperaceae*, notably in *Carex*, the stolons may resemble rhizomes. However, it appears to be a constant character of the stolons in these families that they do not bear green leaves, only membranaceous, scale-like, as we know them from *Agrostis*, *Distichlis*, *Poa*, *Glyceria*, *Agropyrum*, *Muehlenbergia*, *Carex* and several other genera. They always show a different, internal structure from the axis that bears them, while branches of rhizomes show the same structure as the main rhizome itself. Considered at the seedling-stage the *Gramineae* and *Cyperaceae* seldom show distinctly the development of the plumule into a rhizome as shown in *Tripsacum* (fig. 2), at least not in the first or second year. In the caespitose as well as in the stoloniferous species the plumule shows some few green leaves, and the final structure, caespitose or stoloniferous, does not appear until the third or fourth year's growth, when the stolons appear, and as lateral branches from the very short, primary, erect axis. It is often difficult in these two families to decide in mature specimens whether a rhizome or stolons are present, but we must bear in mind that this particular subject has been very comprehensively treated by writers on morphology, and the litera-

[1] Nilsson, N. Hj. Dikotyla jordstammar. Acta Univ. Lund. Vol. 19, 1882–1883.

ture is copious. Moreover stolons are generally slender; *Triadenum* is the only genus, we know of, in which the stolons are composed of thick, fleshy internodes, thus resembling a rhizome. Further investigations of this subject are necessary, however; the object of presenting these notes was to show that the term "rhizome" when applied in the proper manner may as a vegetative structure contribute to the distinguishing of genera or species, as a character supplementary to the floral. The reason, why the writer selected Gray's Manual as a starting point for this discussion, was simply, because we consider it the standard work on American systematic botany. If a future edition of this manual would be elaborated so as to include the morphology of the vegetative organs of reproduction more completely than has been the case heretofore, it would render great assistance to the study of the North American Flora.

Clinton, Maryland.

Explanation of Plates 177 and 178.

Plate 177.

Fig. 1, Polygonatum biflorum. Rhizome of a mature specimen; St. = base of floral stem. Fig. 2, Tripsacum dactyloides, the seedling; R. = the primary root. Fig. 3, same species, a young specimen; P. = the prophylla. Fig. 4, same species, cross-section of the prophyllon. Fig. 5, Medeola virginiana, rhizome of mature specimen, letter as above. Fig. 6, Cardamine Douglassii (Torr.) Britton, rhizome of mature specimen, letter as above. All the figures except fig. 4 are about natural size.

Plate 178.

Fig. 7, Gentiana villosa, rhizome of mature specimen, letter as above. Fig. 8, Podophyllum peltatum, seedling in its third year, letter as above. Fig. 9, Hydrophyllum canadense, rhizome of mature specimen; L. = green leaves, St. = flowering stem. Fig. 10, Dentaria laciniata, seedling showing the one cotyledon free (Cot.), the other enclosed in the seed; L. = the first developed leaf. Fig 11, same species, a mature rhizome; letter as above. Fig. 12, Phryma leptostachya, the pseudo-rhizome of a mature specimen, letter as above. All the figures are about natural size.

Roripa islandica an invalid Name.—Since I followed[1] Schinz & Thellung in taking up for *Roripa palustris* (L.) Bess. the name *R. islandica* (Oeder) Schinz & Thellung, my attention has been directed by Dr. Theodor Holm and also by Mr. Kenneth Mackenzie to the fact, overlooked by me, that the basis of Schinz & Thellung's combination is insecure, since Oeder did not unequivocally publish the binomial *Sisymbrium islandicum*, as has been asserted. Instead, Oeder

[1]Fernald, Rhodora, xxx. 132 (1928).

merely designated the plant by a polynomial, with the queried word "islandicum" in parentheses: "*Sisymbrium*, (islandicum?) *siliquis brevibus*" etc. This is certainly not a clear publication of the binomial *S. islandicum* and I was in error in following Schinz & Thellung without verification. Incidentally, although it is now of but slight importance, Dr. Alfred Becherer of Basel calls my attention to the fact that the combination *Roripa islandica* goes back to Borbás, Balaton Tavának és Partmellékének, 392 (1900), where the combination is published, with *S. islandicum* Oeder as its basis. Under the International Rules *Roripa palustris* (L.) Bess. seems to be the correct name.—M. L. Fernald, Gray Herbarium.

HYDRANGEA PANICULATA NATURALIZED IN MASSACHUSETTS.

R. J. Eaton.

Early in September, my brother, F. W. Eaton reported that he had seen from the road a conspicuous patch of *Hydrangea*, well established in a swamp in Lincoln, Massachusetts, about three-quarters of a mile northeast of the village, and within a stone's-throw of cultivated farm land. I visited the place, and was amazed to find a veritable tangle of *Hydrangea* in full flower, growing in a peaty maple swamp which had been partially cleared perhaps five years ago, judging from the size of those maple sprouts which have successfully competed with the Hydrangea. Although this shrub constitutes the dominant growth in an area of about two acres, other plants such as *Rhododendron viscosum*, *Vaccinium*, *Clethra*, and *Rubus*, were noted in some abundance. Generally speaking, the Hydrangea grew in rather dense irregular clumps at an average height of 1.5 meters. The tallest specimen to be found, growing as a single wand-like sapling on the edge of the clearing in partial shade, was over three meters in height. Most of the clumps were in full sunlight, and bore scores of flowering panicles. Judging from the diameter of the woody stems, ranging from four to eight centimeters at the ground, and from the large number of individual plants growing in a maximum area of perhaps three acres, it is quite probable that the Hydrangea was thoroughly established many years ago. Presumably, it bloomed sparsely if at all while shaded by the maple growth, and became conspicuous only after the trees were cut off. It is probable but not

clearly established that the plants have been propagated by seed. There is no direct evidence of rooting at the tips of the recurved branches. The flowering panicles contain relatively few neutral flowers. About 90% of each inflorescence consists of fertile flowers developing into mature and dehiscing capsules and apparently producing ripe seeds.

Collections from this station have been identified by Prof. M. L. Fernald as *H. paniculata* Sieb., a native of China and Japan. It is said to be the hardiest member of the genus. Originally introduced into America about sixty-five years ago, it has shown no marked disposition to escape from cultivation. In fact, there is no mounted material from naturalized stations to be found at all at the Gray Herbarium, at the Arnold Arboretum, at the New York Botanical Garden, or at the Herbarium of the N. E. Botanical Club. So far as can be learned from such authorities as Fernald, Rehder, and Britton this species has never yet been reported as naturalized in North America. One record only of its escape in New England has been brought to my attention, and that one unimportant, *viz:* in Rhodora XIX: 226 where a plant near a railroad is reported from Connecticut with the erroneous statement that it is a fugitive from the Southern States.

Specimens from the Lincoln station have been deposited in the Gray Herbarium.

Cambridge, Massachusetts.

Victorin's Les Gymnospermes du Québec.[1]—Another detailed monograph from the hand of Brother Marie-Victorin has recently been published. This follows the papers on the ferns and fern-allies and takes up in the same way the Gymnosperms of Quebec. As in the other monographs there are two parts—Révision et Discussion, and Traité Systématique. The former covers only 27 pages, because the nomenclature has been previously discussed in another paper.[2]

Particularly interesting is the discussion of the white and black spruces and their forms, for Brother Victorin recognizes no varietal distinctions in the Quebec species of this genus. He describes one new form, forma *parva*, which he illustrates with three fine half-tone

[1] Les Gymnospermes du Québec. Par Frère Marie-Victorin. xiv + 144 pages, 38 figures et un frontispice. 1927. $1.00. (Contrib. Lab. Bot. Univ. Montréal No. 10.)

[2] Notes pour servir à l'histoire de connaissances sur les Abiétacées du Québec. Par Frère Marie-Victorin. 1926. (Contrib. Lab. Bot. Univ. Montréal No. 7.)

pictures. This is found on the high mountains, on the shore of the Gulf of St. Lawrence, and in northern Ungava. "Trunk very short (1–2 m.), often rather stout (diam. 10–20 cm.), often almost lying on the ground, with the head developed all to one side; branches very numerous forming a close-knit carpet (feutrage)." Thus it is said in Canada that "In Anticosti you walk on the treetops." The corresponding form of *Picea mariana* is forma *semiprostrata* (Peck) Blake.

Picea rubra is included on the basis of one herbarium specimen, and *Juniperus virginiana* on one station, near Hull. The other species are better distributed, and excellent maps show the ranges at a glance.

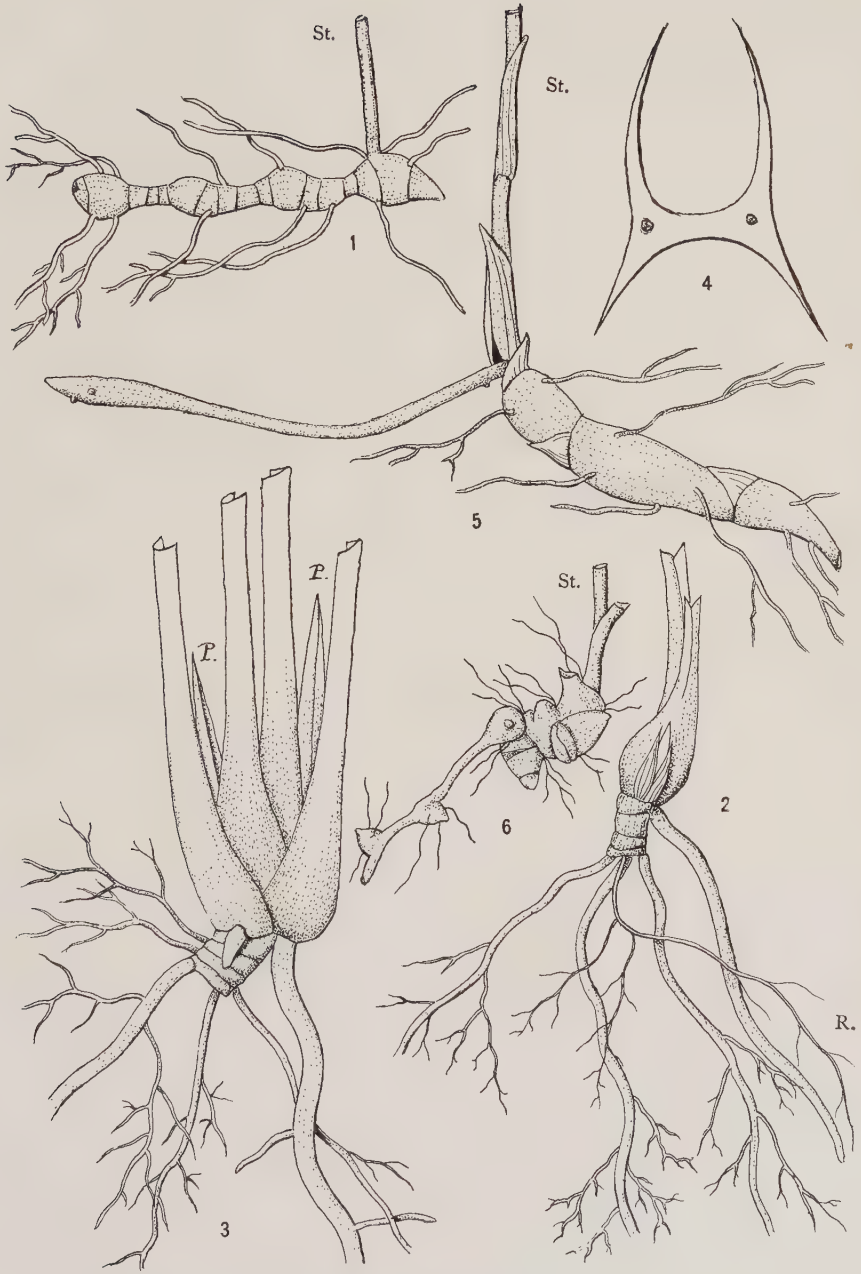
The monograph contains a great deal of valuable information about forestry, and the uses of the woods today and in the past. The fungi and insects which prey on the Gymnosperms are studied in considerable detail.

Brother Victorin gives many facts of interest about the everyday French names of these trees and shrubs. The early settlers of Canada were from a part of France where there were few relatives of the Canadian species, and so evolved their own names for the trees they found in Quebec. Thus *Pinus Banksiana* came to be called cyprés; *Larix laricina*, épinette rouge (among the Acadians violon and hacmatack); *Picea canadensis*, épinette blanche; *Picea mariana*, épinette noir; *Tsuga canadensis*, pruche (in the Magdalen Islands haricot); *Abies balsamea*, sapin; *Taxus canadensis*, buis.

There are many interesting bits of folklore given about the gymnosperms, for these trees were very important in the lives of the early settlers, as well as today. There is included, among other things, a very complete recipe for the manufacture of *bière d'épinette* from the young shoots of *Picea mariana*.

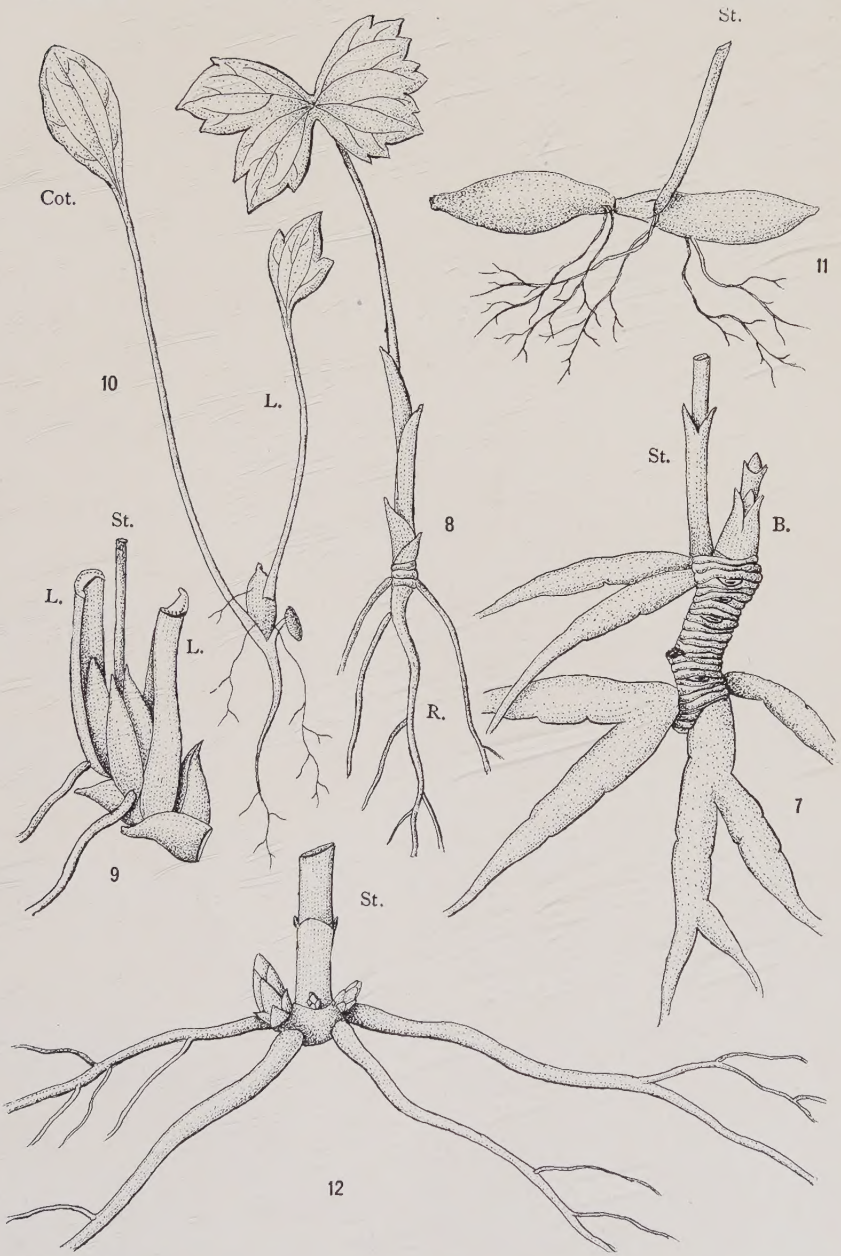
All these interesting bits of general information add much to a monograph which is already rich in its scientific details. The facts about the ranges have been worked out with an infinitude of care, the descriptions of species, varieties and forms are full and accurate, and there are an abundance of diagrams and figures, many of the latter from photographs. The excellent quality of the paper and printing should also receive favorable comment.—Clarence Hinckley Knowlton, Hingham, Massachusetts.

Vol. 30, no. 360, including pages 229 to 258 and title-page of the volume, was issued 24 January, 1929.



Theo. Holm del.

HOLM ON RHIZOMES



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